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# LONG-TERM CORRELATIONS BETWEEN DEMOGRAPHIC VARIABLES AND ECONOMIC GROWTH

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**Abstract:**

*Starting from existing literature and some our recent studies, we developed several modelling schemes that could be useful to improve the strategies oriented to achieve a demographic and economic balance between generations. In this way, we can obtain simulations from a country or group of countries (European Union, for example) on long term and quantify the impact of demographic aging on macroeconomic aggregates, taking into account that usually standard macroeconomic models are general equilibrium models only on short and medium term and the population is considered as an exogenous variable.*

**Keywords:** *demographic aging, overlapping-generations model, demo-economic model, contour plot*

## 1. Introduction

Increased life expectancy and consequently the average age of population are the results of an accelerated economic growth in the modern period. Developing science and technology in recent times, the contribution of technical progress, education and health system led to an increase in the rate of income per capita unprecedented in history. One of the unavoidable consequences was the increasing weight of elders in total population, in other words The Aging Phenomenon.

Starting from existing literature and from recent studies, we developed several modelling layouts that can be useful to substantiate the strategies aimed at achieving an economic and demographic balance between generations. Fundamental feedback underlying the demo-economic modern models, which further allow for demographic variables to become endogenous, refers on the one hand to the fact that an increase per capita income leads to an increased life expectancy and average age for general population. This is the same with demographic aging; hence it can become an inhibitor to economic growth itself in the future. In this area of interest lays our work, namely: the estimation of basic parameters for the demo-economic models and the simulation

of future trajectory of income per capita and other macroeconomic variables which might fall under the impact of the aging phenomenon.

## **2. Empirical evidences, trends and hypotheses**

Today, both globally and by groups of countries, there is an increasing aging phenomenon. This is due, especially in developed countries, to the reduction of female fertility and to a more advanced health system. Therefore, nowadays, in most economic advanced countries we can see a weight reduction for newborn children, while extending life expectancy. Poverty and social exclusion are generally regarded as the biggest obstacles that one must overcome to ensure a decent living for the elderly. Typically, only those who achieve decent revenues and contribute to pension funds, since early stages of life, will be able to avoid poverty in the period in which they leave employment.

As a general worldwide trend, after 1975 the rate of dependency on young people (the number of people aged 0-14 years, compared to that of persons aged 15-64 years) has decreased rapidly, while that the rate of dependency on the elderly (number of persons aged 65 years and over reported to the number of persons aged 15-64 years) increased (though at a slower rate than that of the change in the rate of dependency on young people). Overall, the total dependency rate (resulting from the composition of the two indicators) has registered in a downward trend. In the future, we estimate further decrease in the rate of dependency on young people in parallel with an increased rate of dependency on the elderly. Calculations show that through extrapolation is likely that the two rates become equal before the year 2100 (smoothing is expected to manifest for values between 30-35% of young people and adults, i.e. people aged 15-65 years). For comparison, between six and eight decade of the last century the rate of dependency on young people was over 60% (a maximum over 65% recorded during 1965-1970) and the rate of dependency on elderly was placed under 10%.

Numerous studies, both theoretical and based on available empirical data, show that on long-term there is a significant correlation between demographic variables and level of economic development. These correlations are also widely used in the so-called model of overlapping generations. The main correlation resulting from the simple analysis of statistical data is that between life expectancy of general population and the level of economic development. Thus, it has been proven that as a general long-term trend, when GDP per capita increases due to better living, the average lifespan of the population and life expectancy increase too. The relationship between GDP and life expectancy may be analysed also in a reverse way. Namely, along with increased quality of life and life expectancy, we get an increase of the active life on population; thus resulting an increase in the overall productive capacity of a country and therefore of GDP per capita. If we take the European Union (EU-27), in 2003 and 2006, the above-mentioned correlation is presented graphically in Figure 1 (where the countries in EU are noted as *i*, in ascending order on the horizontal axis relating to the GDP per capita level in euros in 2006, starting with Bulgaria, registering

the lowest level, until Luxembourg with the highest level; and on the vertical axis we have life expectancy in EU countries, expressed in years, denoted by  $v$ ).

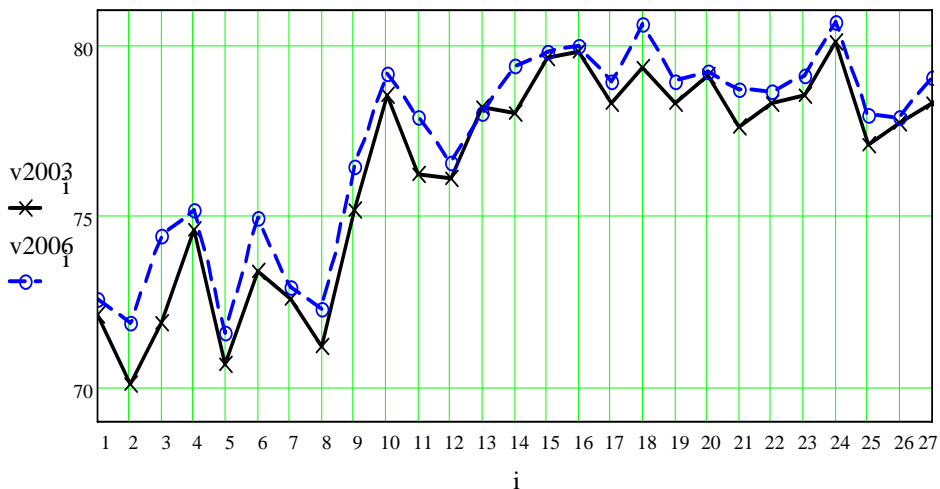


Figure 1.

One significant factor having impact on the demographic development - economic growth relationship is the birth-rate or fertility index (expressed by the number of children by one woman during her fertile life). General worldwide historical trend has a declining fertility rate related to the increase in the economic development level. In EU, however, empirical evidence for recent years (2003 and 2006) seem to reject this hypothesis, as seen from the graphical representation of the correlation between GDP per capita and fertility rates in Figure 2 (where on the vertical axis is the fertility rate,  $f$ , and on the horizontal axis are countries within EU,  $i$ , ordered ascending by the GDP per capita in euros in 2006). On the other hand, if we take the infant mortality rate (computed as ratio between the number of dead children at 1,000 children born alive), unlike that of fertility, the hypothesis of inverse correlation relative to the level of economic development is true for recent years (2003 and 2006), both globally and for the European Union, as is suggested by the graphical representation in Figure 3 (where infant mortality is denoted by  $m_0$  on the vertical axis, and on the horizontal axis are countries within EU, denoted by  $i$ , ordered ascending by GDP per capita in euros in 2006).

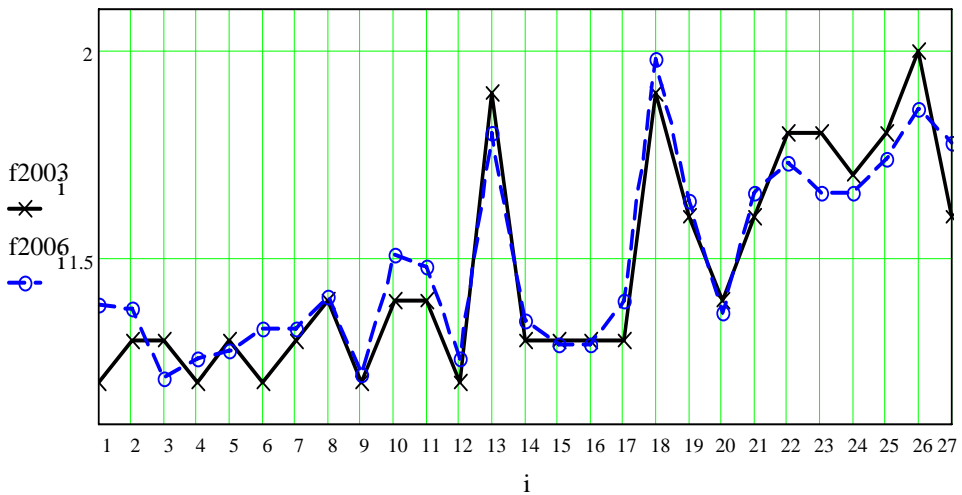


Figure 2.

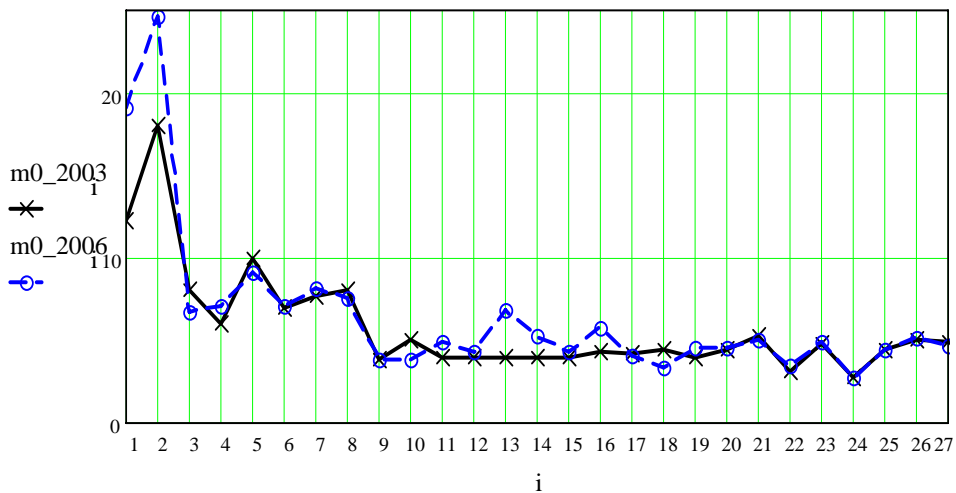


Figure 3.

According to recent data, in 2003 and 2006, in case of EU countries a series of significant correlation between demographic indicators registered, which could be an important milestone for projections of demo-economic development in the future. Thus, within the geographical area of EU based on empirical data, there is a direct logistic-type correlation between life expectancy,  $v$ , and fertility,  $f$  (Figure 4) and an inverse hyperbolic one between life expectancy and infant mortality,  $m_0$  (Figure 5). In addition, another inverse hyperbolic-type relationship seems capable of satisfactory estimation of the correlation between fertility and infant mortality (Figure 6).

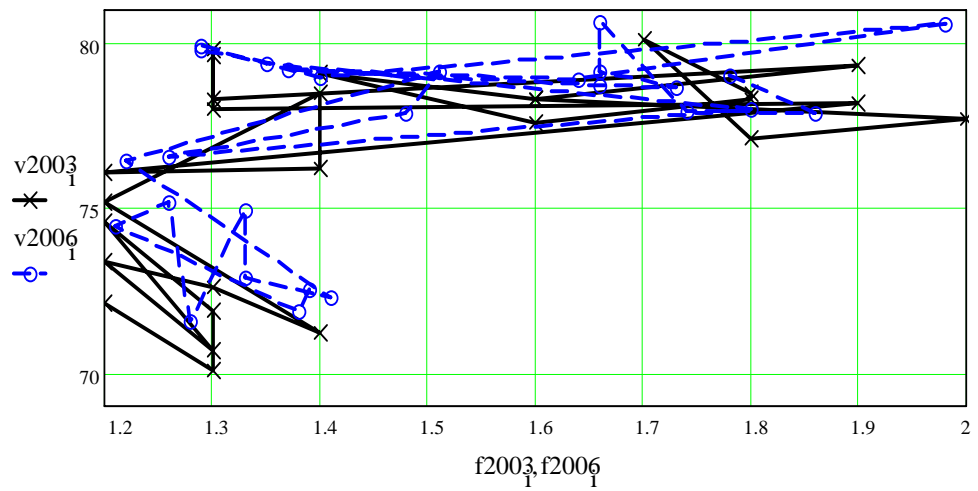


Figure 4.

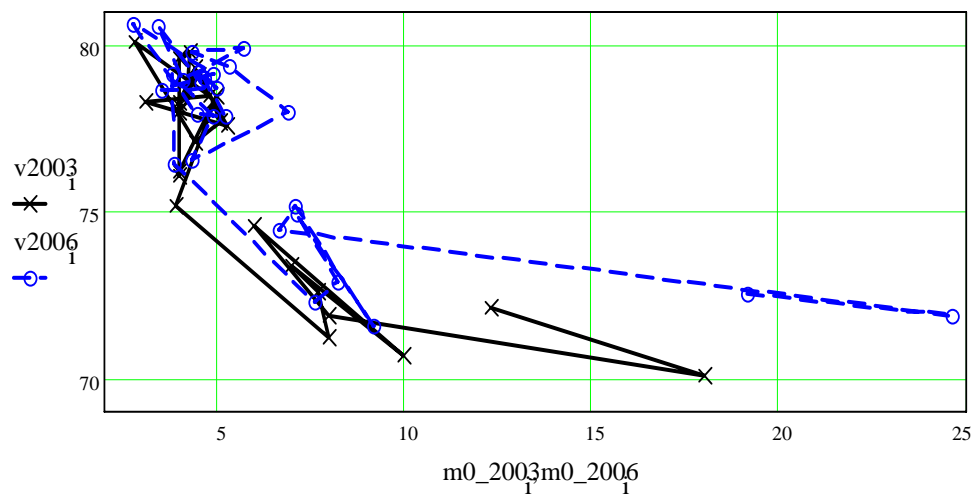
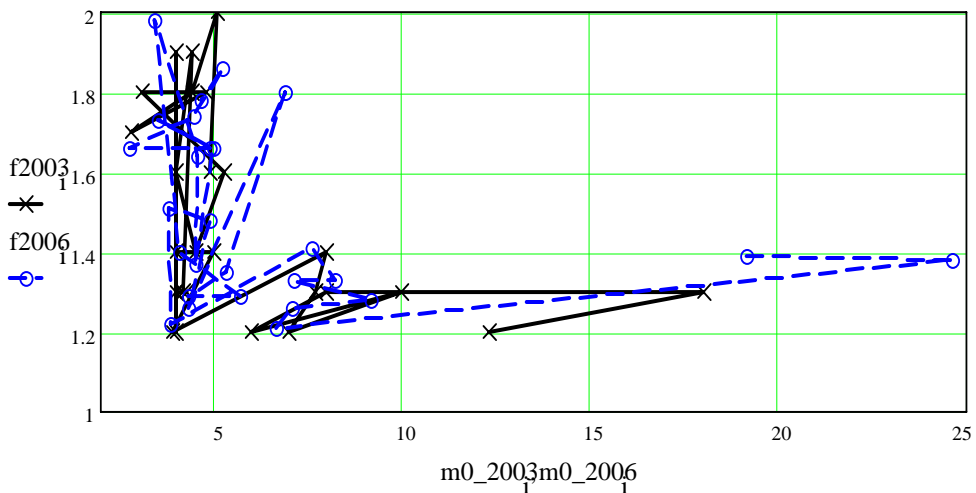


Figure 5.



**Figure 6.**

In fact, the relation between demographic variables and macroeconomic ones is more complex than in the case of considering some simple correlations between only two variables. In order to study further complex correlations, a first step might be the representation of variables dynamics in 3D space. In the case of European Union, a significant number of such 3D images along with the so-called “geodesic maps” (or “contour plot”) attached to them, for 2003 and 2006, are presented in Annexes 1-4. A more refined analysis facilitated by these, could be used to develop some appropriate quantitative models for the geographical area of EU, to obtain significant conclusions for future trends, and to conceive a coherent set of policy measures in the field. As an example, we present some useful elements, derived from the analysis of spatial representations for the year 2006.

Based on the spatial representation of the correlation Life expectancy - Female fertility - GDP per capita (v-f-y) in Annex 1, we can see that the highest rates of GDP per capita (the area marked on the “geodesic” map with intense red colour, bounded by the contour line 40, representing thousand euros per capita) correspond in 2006 to a life expectancy ranging between approximately 78-81 years and with a female fertility placed approximately in the range 1.65-1.95. On the other hand, the lowest GDP per capita in the EU (the area marked by intense blue colour, bounded by the contour line 10 thousand euros per capita) correspond in the same year to a life expectancy below 76 years and to a fertility rate below 1.45.

In Annex 2 is presented the spatial correlation GDP per capita - Female fertility - Life expectancy, which is just another view on the relationship between the same three variables as in Annex 1, produced by the rotation of axes of coordinates. For instance, based on the “geodesic map” for 2006 one can observe that a life expectancy over 79 years (the regions marked with red colour) usually corresponds to a level of GDP per capita over 15 thousand euros. Moreover, it can be concluded that, in most cases, the level of GDP per capita instead of fertility has a strong influence upon life

expectancy (this could be concluded on the fact that, mostly for values of GDP per capita below 30 thousand euro, there are some vertical coloured bands almost parallel).

The representation of the spatial correlation GDP per capita - Infant mortality - Life expectancy, in Figures from Annex 3, allows a more refined interpretation. Thus, one can observe, for the year 2006, as a rule, for values of GDP per capita over 15 thousand euros and an infant mortality more than 6 at one thousand live births, that the level of infant mortality instead of GDP per capita influences life expectancy stronger (a conclusion based on the fact that in the above mentioned region there are some horizontal coloured bands almost parallel). Based on Figures in Annex 4, which show the spatial correlation among demographic variables: Infant mortality - Female fertility - Life expectancy, one can find that, in 2006, the life expectancy decreased (the transition from the red to the blue regions) if the infant mortality will increase and/or fertility decrease. Conversely, life expectancy will increase (transition from the blue to the red regions) if the infant mortality will decrease and/or the fertility increases.

### **3. Forecast and simulation models**

In the economic literature, starting from the classical model of Ramsey (which implies the existence of a representative consumer with an infinite lifespan and that makes decisions on the optimal consumption-saving ratio), there has been developed in recent decades, a class of models that attempt to capture the correlation between changes in age structure of the population, or the so-called aging demographic, and economic growth. Nowadays, they are known, as models of overlapping generations. Subsequently, we propose some simple modelling schemes that may prove useful in future efforts to study correlations between demographic variables and economic development, and in addition achievement of possible forecasts on the impact of aging population phenomenon related to growth, based on statistical data currently available.

Yaari (1965) has identified the two major complications that may occur in a model that takes into account the uncertainty of lifespan (note that in the standard Ramsey model there is no uncertainty on the lifetime). First, the assumption of expected utility must be used, thus the whole life expectancy utility becomes the objective. Secondly, the restriction of non-negativity regarding the agent's property at the time of his death is similarly stochastic since it depends also on the random moment of death. Based on Yaari's model one can reach the following conclusion: the survival uncertainty makes households to settle for the future more difficult, i.e. the subjective rate of time preference in the event of uncertainty upon lifetime is greater than in a classical case (if there is a positive probability that a person might not live long enough for it to enjoy a certain future consumption, then it tends to treat more difficult the time preference). Without further details of his theoretical developments in the case of a single consumer, we will mention however that Yaari has suggested that we should use a special type of life insurance based on the so-called insurance policies (also known as actuarial notes or bonds) used by insurance companies. Referring strictly to the consumer choice issue and taking into account Yaari's analysis,

the consumer will always hold its funds in the form of financial insurance policies, that is he or she will ensure against the possible loss of life.

The results of Yaari's approach remained unused until Blanchard (1985) who transformed the central elements of his own continuous-time model for chained generations, which subsequently became one of the key models in the modern macroeconomic theory. Blanchard had significantly simplified Yaari's model assuming that, the probability density function for death of a consumer is exponential. Rather than assume a probability of instantaneous age-dependent death (as in the case of Yaari's model), Blanchard assumed that the rate of hazard is constant and independent with the consumer's age. Such an approach had several advantages. The first is that it leads to optimal consumption rules that can be easily aggregated for households. Thus, there is a possibility to maintain a high level of aggregation in the model, although the consumers' population is heterogeneous through age relation. Secondly, the remaining life expectancy for each agent is equal to  $1/\beta$  (where  $\beta(\tau)$  is the so-called hazard rate or instantaneous probability of death at  $\tau$  moment), and, if  $\beta=0$  is fixed, Blanchard's model coincides with the Ramsey's agent representative model. Such extended model, called Blanchard-Yaari, is a time-continuous model of chained generations, which, due to its flexibility has been widely used as a central model in a series of applications of macroeconomic theory. The key element that distinguishes the Blanchard-Yaari model from the Ramsey's one is that the former makes distinction between agents according to their date of birth, while the latter involves only a single representative agent. By incorporating advanced modelling tools, Yaari-Blanchard model can be solved and analysed at a macroeconomic level, although individual households are heterogeneous. Its flexibility allowed an expansion of the model in various directions. One of these extensions considers endogenous labour supply, which plays a central role for a number of economic theories (such as that of the real business cycle). Such extensions of the model allowed the study of significant issues regarding the dynamics of the economic system under the impact of economic policy measures. Among the extended Blanchard-Yaari's model applications, we therefore state: the study of dependence on age based productivity, the economies' dynamic in an open economy model, the impact on growth of investments or wage dynamic, the estimation of financial assets and human capital, etc.

The main consequence of the time-continuous Blanchard-Yaari's model, whose basic assumption is perpetual youth, lies in that a finite lifetime horizon can be properly analysed. Instead, the model failed in the case of evaluating the aspects of consumption over the life cycle. Of course, in the standard Blanchard model, the age of one household affects the level and substance of its assets (first issue), but not its inclination towards consumption outside the limit imposed by the sum of held assets (an aspect related to the life cycle). In the absence of a testamentary reason and with a finite life, it is expected that an elder agent to have a penchant for consumption more than a young agent, primarily because the former agent has a shorter planning horizon of life (or a higher risk of death) than the latter. A simplest model, which captures both



finite horizon and the lifecycle of the household, was designed by Diamond (1965), from a preliminary study of Samuelson (1958). The model, known today as the Diamond-Samuelson model, is one with discrete time and it has become the core for many areas in economic sciences. This model, in its standard form, includes the block of households and the block of companies, and some restrictions over the market equilibrium.

In the Diamond-Samuelson model, one can consider that individual agents live two periods. In the first period (youth), they work, and in the second (old), they are withdrawn from employment. Since agents will want to consume in both periods of life, they will save during youth and then will stop saving in the old age period. During the first period, the agent offers an inelastic labour for which he receives a salary, which further on is spent on consumption and saving. During the second period, the agent no longer works, but receives income from interest on its savings. The initial fond plus interest is spent for consumption in old age. Therefore, the household is subject to two budget identities, as with the period of youth and than old age. Without further detailed equations for Diamond-Samuelson model, we mention that it allows an specific approach in the context of chained generations, for some significant problems at a macroeconomic level; such as studying the behaviour of households and firms, the equilibrium market conditions, the dynamics and stability of the economic system restrictions, the trajectory of effectiveness, the mechanism of operation in the pension system (as is the standard one, Pay-as-you-go or PAYG), the equivalence between PAYG and funding of government debt through deficit, the relationship between PAYG type pensions and the endogenous retirement, the welfare effects, the macroeconomic effects of the aging phenomenon. Subsequently, the Diamond-Samuelson model was developed and its main extensions were targeting human capital assessment and its mechanism of formation, the explaining of the relationship human capital - education, estimating the impact of public investment, the quantifying parameters of the so-called golden rule of accumulation and the impact of intergenerational relationships upon the dynamics of the economic system, etc

Overlapping-generations models are used in particular for their valences at a theoretical level. In many cases, they demonstrate the complexity of economic agents' behaviour and economic system in general. When some of the basic parameters of the models overcome certain thresholds, the systems can move successively from stable regimes of behaviour to some cyclical and even chaotic ones. In addition, besides the reported problems, chained generations models, mainly with theoretical values, are usually applied in hard cases for developing forecasts and/or substantiating the macroeconomic policies. Therefore, economists use in parallel, for analysis and forecasting, a series of simple theoretical models, which can facilitate the quantification and simulation of economic processes and mechanisms. To this regard, one can devise a scheme by which modelling could try to quantify the link between the aging phenomenon of population and the basic factors of economic growth, i.e. labour and capital, starting from the simplified form of the general structure of the population:

$$P = P_I + P_{II} + P_{III}$$

(1)

where  $P$  represents total population,  $P_I$  – young population, with ages below 15 years,  $P_{II}$  – adult population, with ages between 15-64 years, and finally  $P_{III}$  – old population, 65 years and above. Also, in relation with adult population, without explanation for unemployment and considering that  $P_{II} = L$ , potential labour force, the employment rate,  $\mu$ , can be written:

$$\mu = L_o / L$$

(2)

where  $L_o$  is employed population, i.e. one that ensures the achievement of GDP,  $Y$ .

The implications of changing the age structure of population and particularly the aging phenomenon, which can be measured through increase in the share of elderly population,  $P_{III}$ , per total, one can still include in a production function,  $Y$ , one factor,  $Y(L)$  or two factors,  $Y(L,K)$ , usually a Cobb-Douglas type.

It is already an axiom that increasing life expectancy and low fertility women are among the main causes that generate the phenomenon of aging, which in turn leads to long-term decrease in the total population. Today, in all developed countries there is an accentuated phenomenon of aging. In many developed countries, throughout Europe there is already a natural decrease of total population (In spite of infant mortality that reached very low values), only net immigration makes total population still not fall to steep, and according to specialized international bodies, in the next three decades, it is very likely that all this geographic area to be affected with aging (due to the fact that it provides further immigration, it is likely that declining population in some way is lagged).

In order to apply various models to quantify the impact of demographic aging on the economic dynamics and for attempting various forecasts for Romania it would be useful to estimate present correlations related to the geographical area of European Union. Using the latest data available, we estimate some econometric correlations where demographic variables are involved, as follows.

In the last few years, in the case of EU, there is a significant direct linear correlation between the level of economic development,  $y$ , on the one hand, and life expectancy,  $v$ , female fertility,  $f$ , and infant mortality,  $m_0$ , on the other hand, expressed by the regression equation having the following form:

$$y(v, f) = a_0 + a_1 \cdot v + a_2 \cdot f + a_3 \cdot m_0 + u$$

(3)

where  $a_0$ ,  $a_1$ ,  $a_2$  and  $a_3$  are estimated coefficients,  $u$  - residue. Synthetically, the results of estimation for 2006 are:  $a_0 = -169.4906315$ ;  $a_1 = +1.886628779$ ;  $a_2 = +32.3015554$ ;  $a_3 = -0.3307476105$ . In figure 7, we represent the real

data series for GDP per capita,  $y$  (continuous line) and its estimations,  $y_E$  (dashed line), on the horizontal axis there are all 27 countries from EU (ascending ordered by GDP per capita expressed in euros in 2006). Moreover, on this Figure there are presented the curve of minimum values,  $y_L$ , and that of maximum values  $y_U$ , which bounds the range of the statistical confidence interval (the two dashed lines).

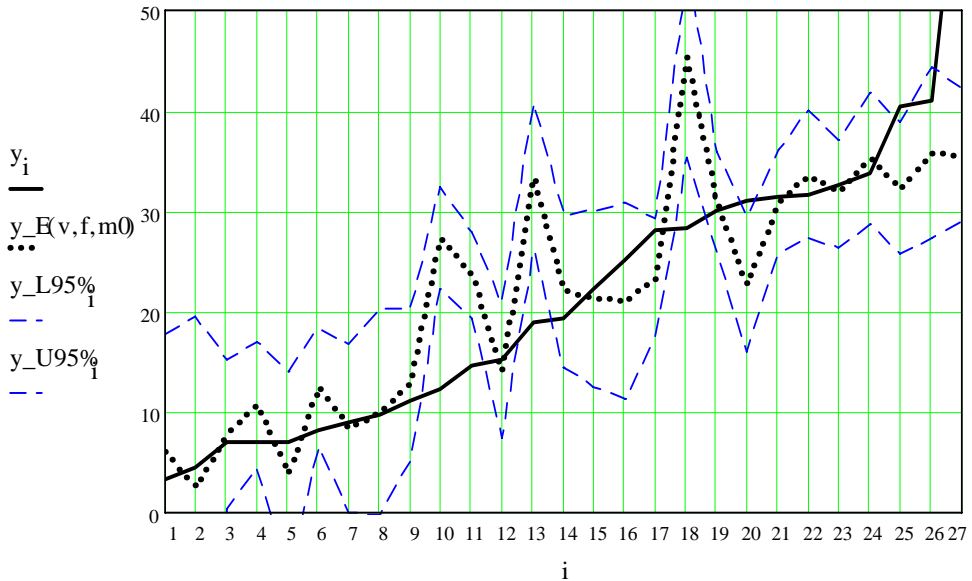


Figure 7.

If one studies individually the relationships between the level of development and the life expectancy,  $y-v$ , between level of development and fertility rate,  $y-f$ , and finally between level of development and infant mortality,  $y-m0$ , one can observe the existence of some direct significant correlations, but in this case they are of a logistic type (for the first two demographic variables), and a hyperbolic type (for the last considered variable). Among the regression equations, which describe the correlation of inverse relationship we have selected the following ones:

$$v(y) = \{b_0 / [1 + b_1 \cdot e^{(-b_2 \cdot y)}]\} + u \quad (4)$$

$$f(y) = \{c_0 / [1 + c_1 \cdot e^{(-c_2 \cdot y)}]\} + u \quad (5)$$

$$m0(y) = d_0 + (d_1 / y) + u \quad (6)$$

where  $b_0$ ,  $b_1$ ,  $b_2$ ,  $c_0$ ,  $c_1$ ,  $c_2$ ,  $d_0$  and  $d_1$  represent estimated econometric coefficients for each equation,  $e$  is the natural logarithm basis, and  $u$  represents the residue for all three. Synthetically, the results of estimations for 2006 are:  $b_0=+79.49903726$ ;  $b_1=+0.1792495991$ ;  $b_2=+0.1229746193$ ;  $c_0=+1.962115342$ ;  $c_1=+0.6290018541$ ;  $c_2=+0.03422126024$ ;  $d_0=+1.849366498$ ;  $d_1=+56.47572196$ .

In Figure 8, we represent a series of actual data compared to life expectancy,  $v$  (continuous line) and its estimations,  $v\_E$  (dotted line), on the horizontal axis there are countries in EU as in Figure 7. Moreover, on Figure there are presented the curve of minimum values,  $v\_L$ , and that of maximum values  $v\_U$ , which bounds the range of the statistical confidence interval (the two dashed lines).

In Figure 9, there are represented comparatively the actual data for fertility,  $f$  (continuous line) and its estimations  $f\_E$  (dotted line), on the horizontal axis there are countries in EU as in Figure 7. On Figure there are presented the curve of minimum values,  $f\_L$ , and that of maximum values  $f\_U$ , which bounds the range of the statistical confidence interval (the two dashed lines).

In Figure 10, there are presented the actual data series for infant mortality,  $m_0$  (continuous line) and its estimation  $m_0\_E$  (dotted line), on the horizontal axis there are countries in EU as in Figure 7. Also there are presented the curve of minimum values,  $m_0\_L$ , and that of maximum values  $m_0\_U$ , which bounds the range of the statistical confidence interval (the two dashed lines).

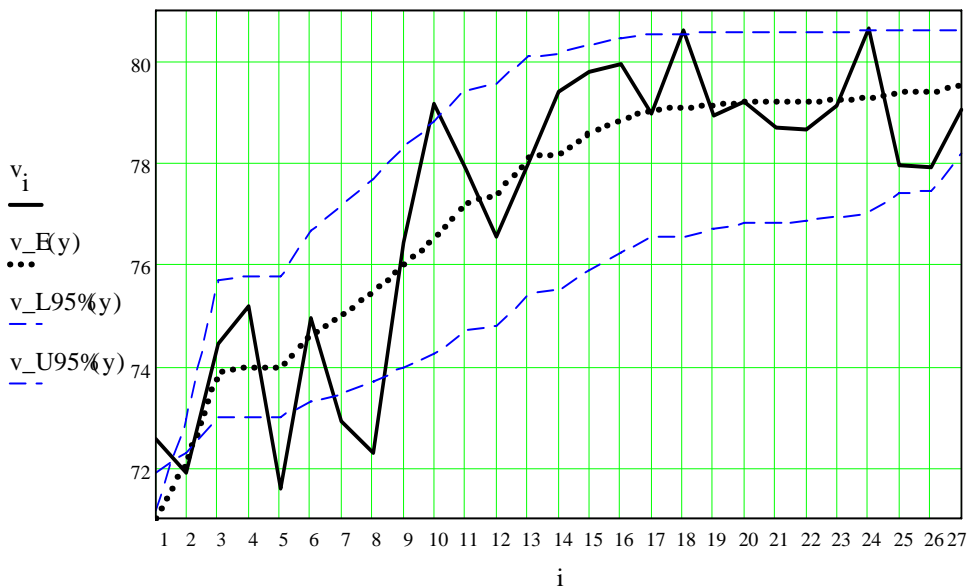


Figure 8.

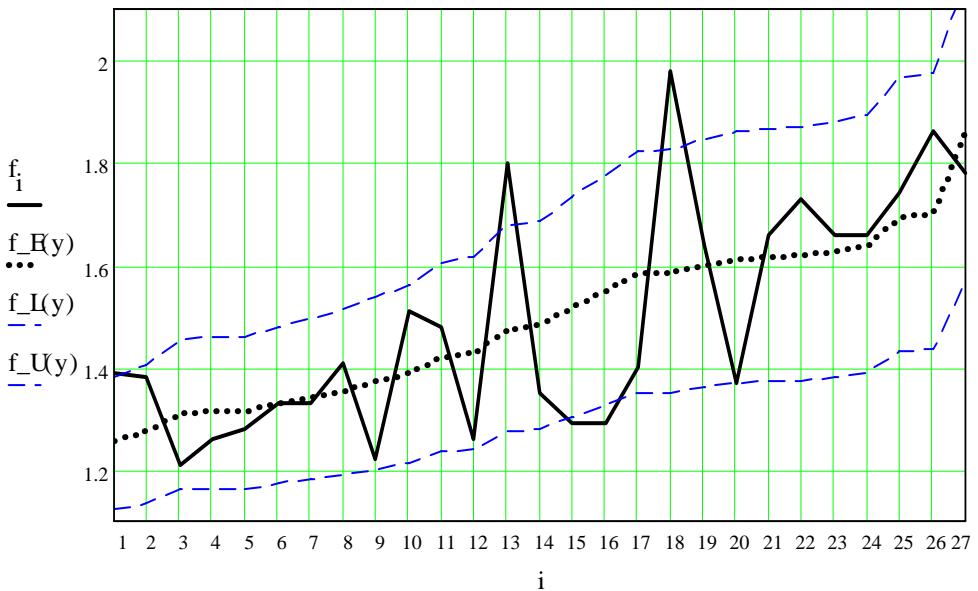


Figure 9.

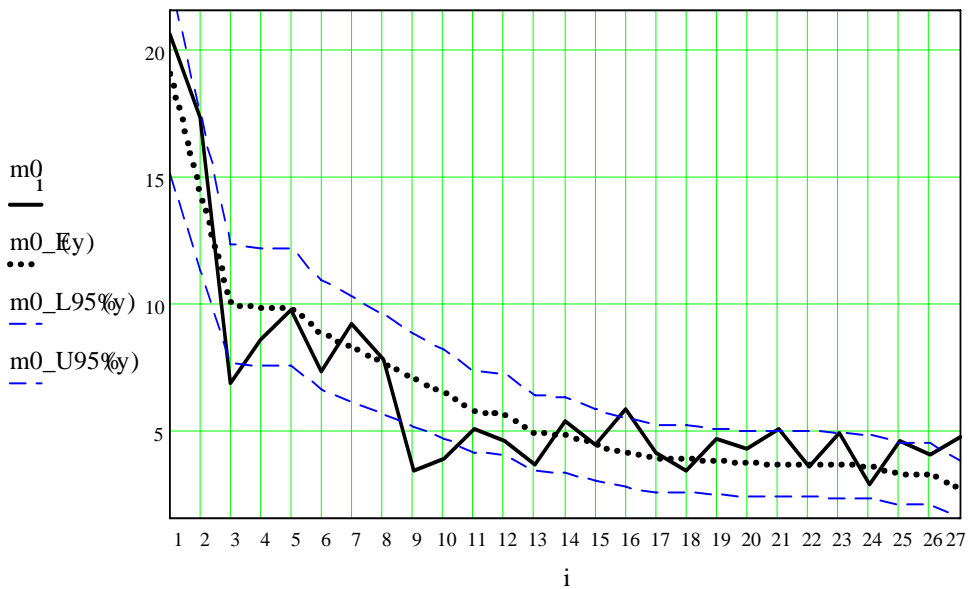


Figure 10.

To achieve plausible forecasts regarding the dynamic correlation between demographic variables and economical ones, and as a consequence for proper foundation for both measures of economic policy and the impact on population, there is certain need, along with the use of information and results analysis at an worldwide and European level, for constructing some regression functions specific to each country. On short and medium term, the correlations and estimate the parameters of

the regression functions can even deviate significantly from long-term trends, which reflect the laws of economic and demographic. However, on long and very long term, the trajectories of national or regional level will converge towards their general demonstrated curves. In this sense, the consideration of such information and studies, provided by specialized international bodies, becomes a priority, especially when the final policies and strategies on short and medium term are drawn.

Regarding the forecasting studies on the impact of changes for demographic variables and the phenomenon of aging population, upon economic growth, one can also prove the models and theoretical trajectory of such variables. For example, for the above-mentioned three demographic variables, the long-term trajectories (or theoretical trajectories) can be calculated depending on the future development of GDP per capita based on regression equations presented. The graphics of the three theoretical trajectory (dotted lines) depending on the level of economic development are presented in Figures 11-13 (the significance of symbols is the same as in Figures 8-10, with the difference that the horizontal axis, instead of  $i$ , representing the 27 EU countries grouped on an ascending level of GDP per capita, we are using now the actual level, expressed in thousand euros per capita in 2006). The theoretical trajectories estimated by available data for 2006 for EU countries demonstrate the convergence on long-term (considered because the “development arrow” implies a continuous growth of GDP per capita in the future) to certain constant values of the three basic demographic variables: a) the life expectancy converges on long term towards a maximum represented by the asymptote  $b_0=79.50$  years; b) the female fertility converges on long term towards a maximum represented by the asymptote  $c_0=1.96$  births per woman; c) the infantile mortality converges on long term towards a minimum represented by the asymptote  $d_0=1.85$  deaths at 1000 born alive.

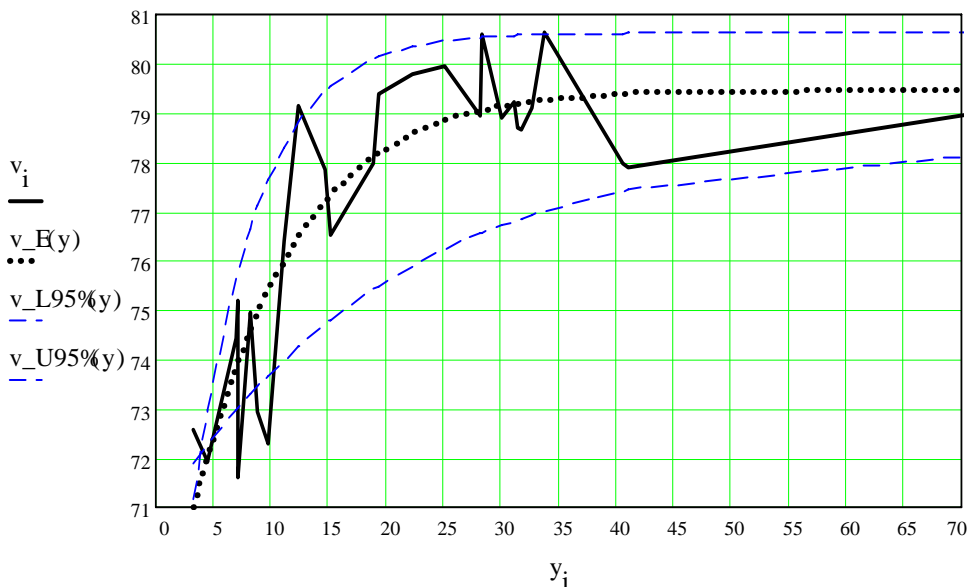


Figure 11.

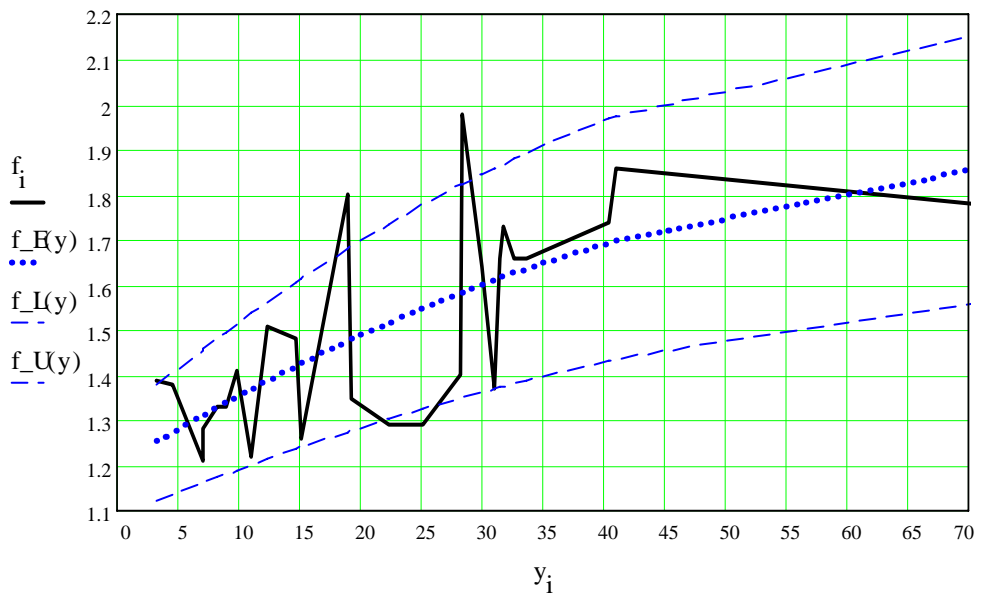


Figure 12.

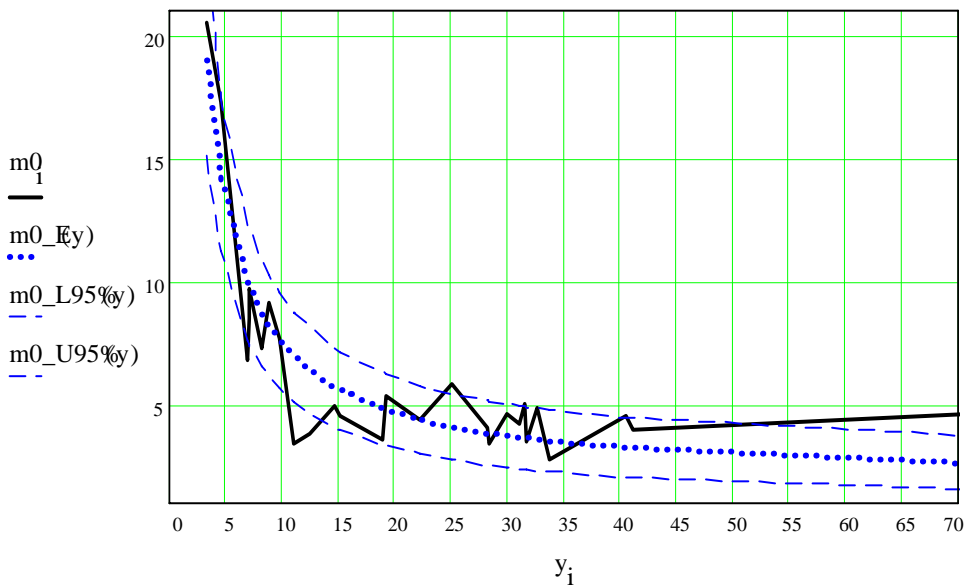


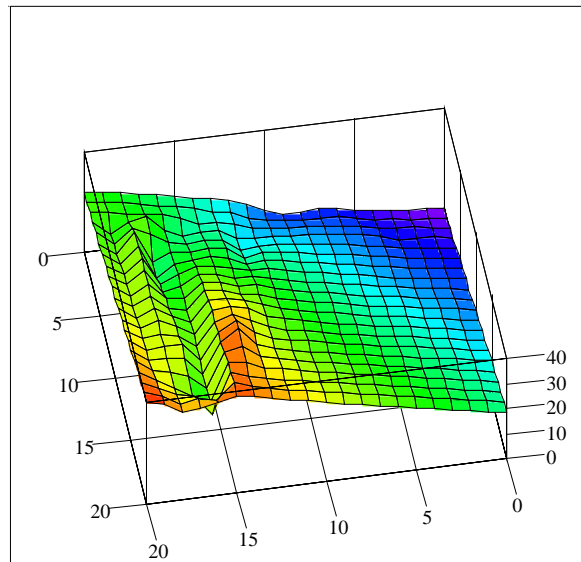
Figure 13.

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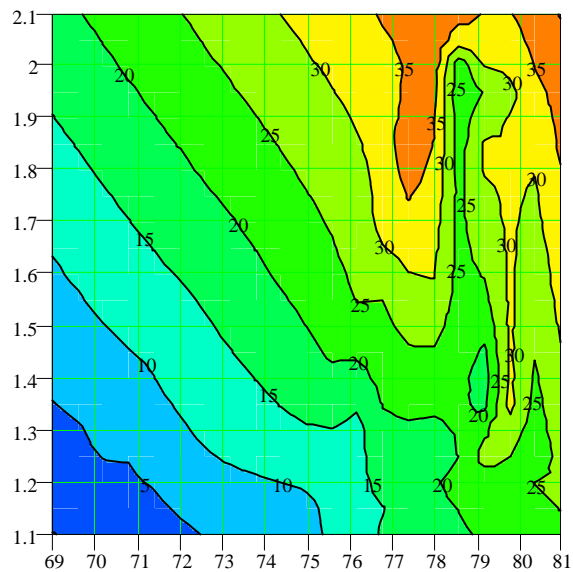
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**Correlation: Life expectancy – Female fertility – GDP per capita**



v2003, f2003, y2003



v2003, f2003, y2003

$$\min(v2003) = 70.1$$

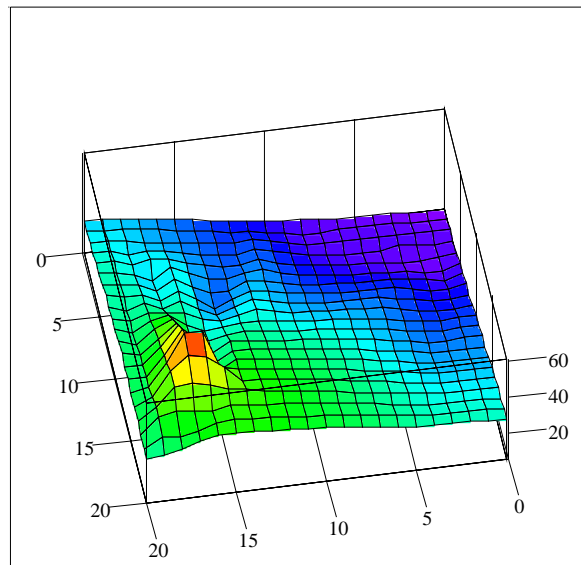
$$\max(v2003) = 80.1$$

$$\min(f2003) = 1.2$$

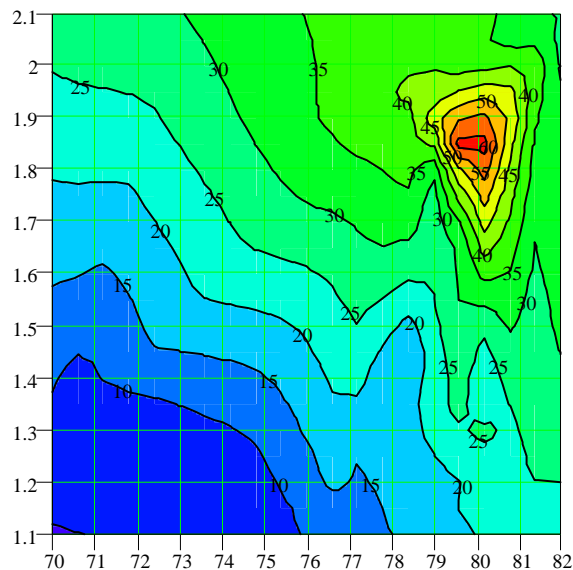
$$\max(f2003) = 2$$

$$\min(y2003) = 2.551$$

$$\max(y2003) = 59.152$$



$v_{2006}, f_{2006}, y_{2006}$



$v_{2006}, f_{2006}, y_{2006}$

$$\min(v_{2006}) = 71.6$$

$$\max(v_{2006}) = 80.63$$

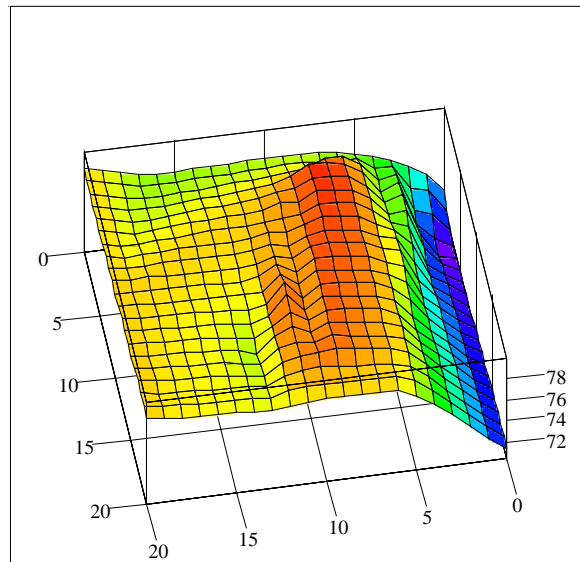
$$\min(f_{2006}) = 1.21$$

$$\max(f_{2006}) = 1.98$$

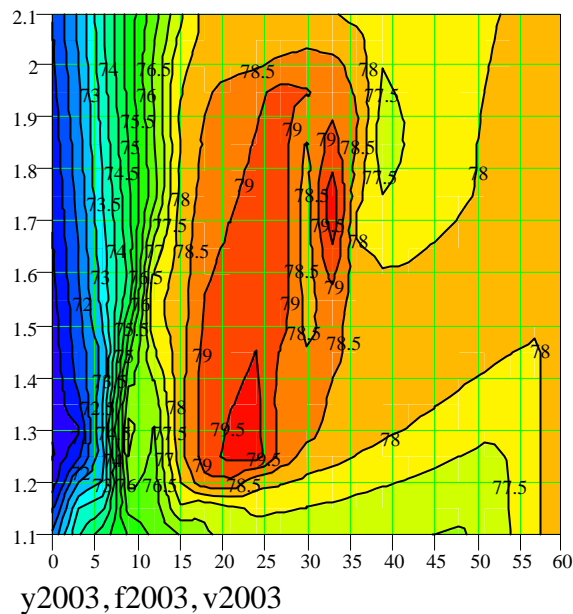
$$\min(y_{2006}) = 3.3$$

$$\max(y_{2006}) = 71.6$$

**Correlation: GDP per capita – Female fertility – Life expectancy**



y2003, f2003, v2003



$$\min(y2003) = 2.551$$

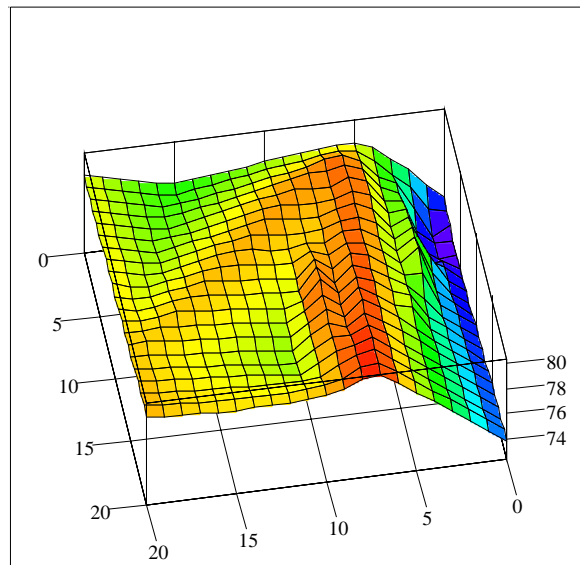
$$\max(y2003) = 59.152$$

$$\min(f2003) = 1.2$$

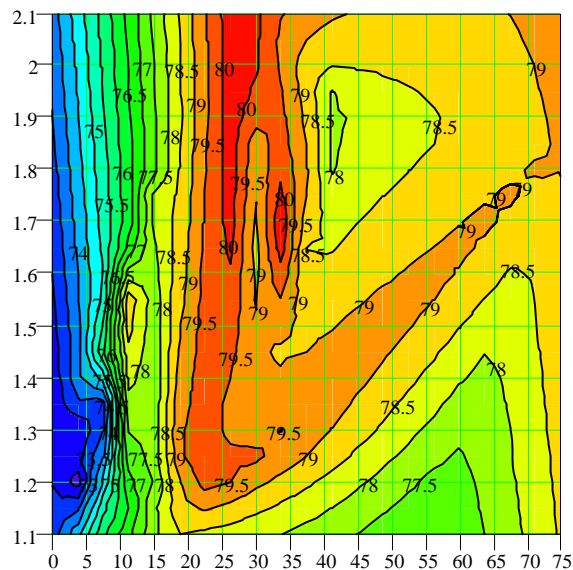
$$\max(f2003) = 2$$

$$\min(v2003) = 70.1$$

$$\max(v2003) = 80.1$$



y2006, f2006, v2006



y2006, f2006, v2006

$$\min(y2006) = 3.3$$

$$\max(y2006) = 71.6$$

$$\min(f2006) = 1.21$$

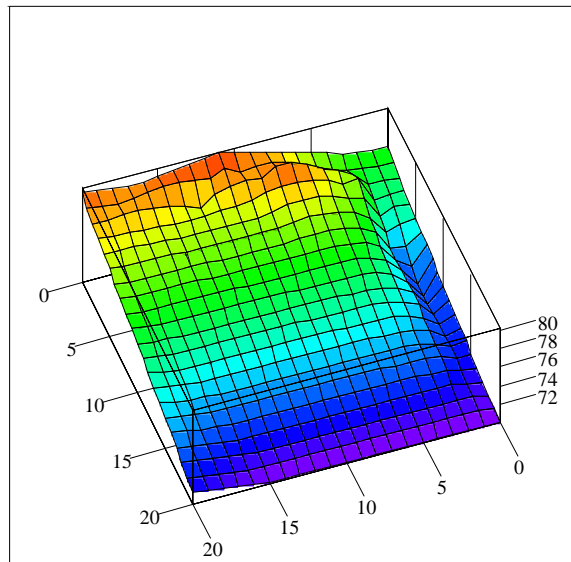
$$\max(f2006) = 1.98$$

$$\min(v2006) = 71.6$$

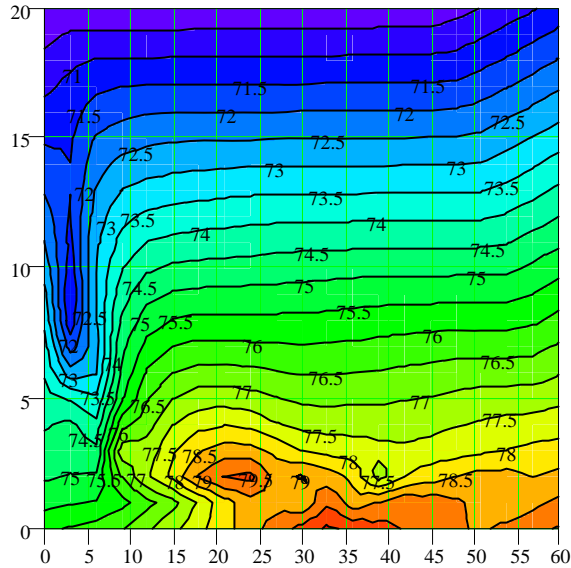
$$\max(v2006) = 80.63$$

Annex 3

Correlation: GDP per capita – Infantile Mortality – Life expectancy



y2003,m0\_2003,v2003



y2003,m0\_2003,v2003

$$\min(y2003) = 2.551$$

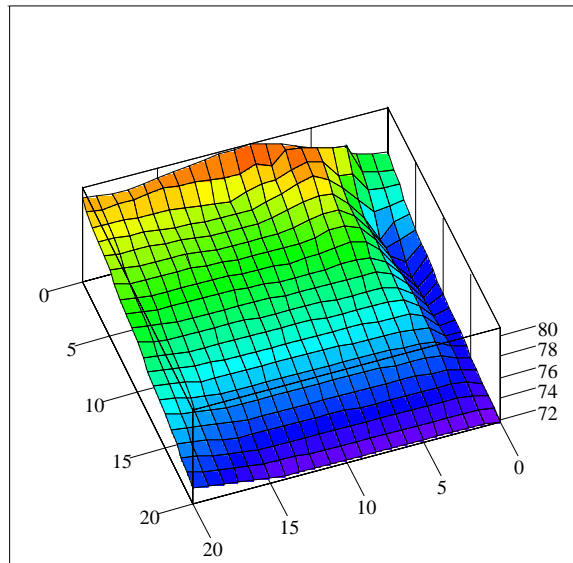
$$\max(y2003) = 59.152$$

$$\min(m0\_2003) = 2.8$$

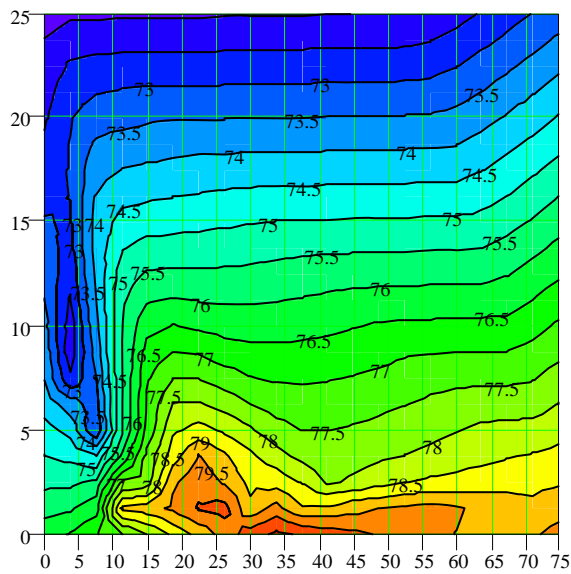
$$\max(m0\_2003) = 18$$

$$\min(v2003) = 70.1$$

$$\max(v2003) = 80.1$$



$y_{2006}, m0\_2006, v_{2006}$



$y_{2006}, m0\_2006, v_{2006}$

$$\min(y_{2006}) = 3.3$$

$$\max(y_{2006}) = 71.6$$

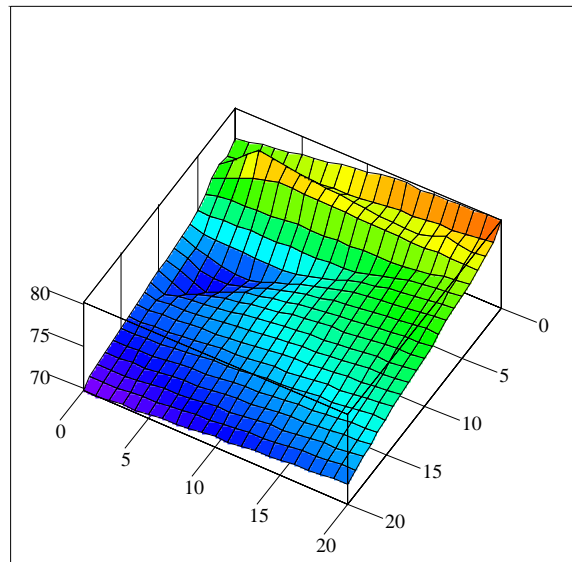
$$\min(m0\_2006) = 2.76$$

$$\max(m0\_2006) = 24.6$$

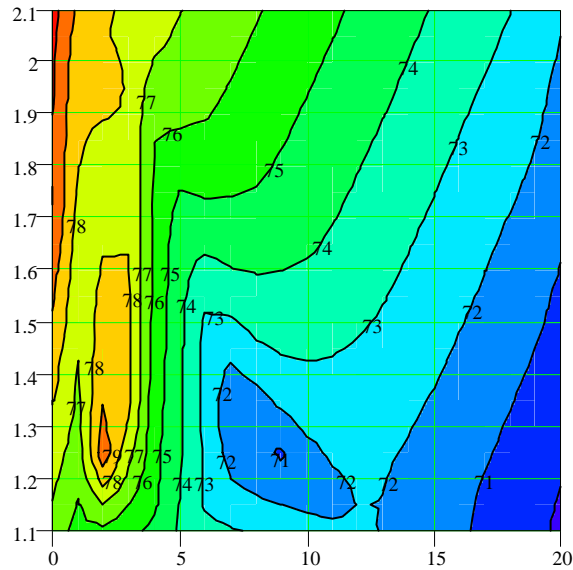
$$\min(v_{2006}) = 71.6$$

$$\max(v_{2006}) = 80.63$$

**Corelația: Infantile mortality – Female fertility – Life expectancy**



m0\_2003, f2003, v2003



m0\_2003, f2003, v2003

$$\min(m0\_2003) = 2.8$$

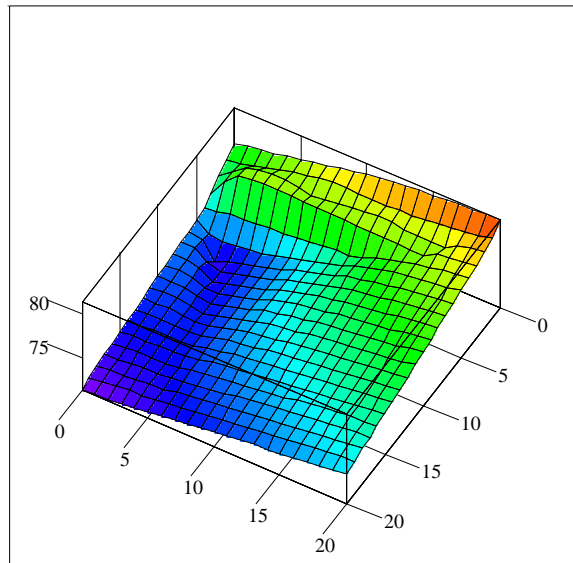
$$\max(m0\_2003) = 18$$

$$\min(f2003) = 1.2$$

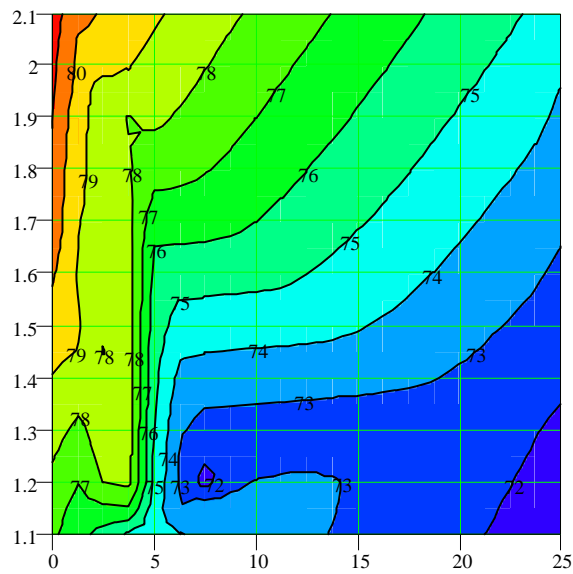
$$\max(f2003) = 2$$

$$\min(v2003) = 70.1$$

$$\max(v2003) = 80.1$$



m0\_2006, f2006, v2006



m0\_2006, f2006, v2006

$$\min(m0\_2006) = 2.76$$

$$\max(m0\_2006) = 24.6$$

$$\min(f2006) = 1.21$$

$$\max(f2006) = 1.98$$